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IoT Based Solar Panel for Power and CurrentMonitoring

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Abstract: The Internet of Things envisions the internet extending into the real world, including common things. The Internet of Things allows things to be sensed or controlled remotely using existing network infrastructure, allowing for full integration of the real world into computer-based systems and resulting in enhanced efficiency, accuracy, and economic gain, as well as less human interaction. This technology has several uses, including solar cities, smart villages, microgrids, and solar street lighting, among others. During that same time frame, renewable energy increased at a quicker rate than at any previous time in history. The suggested systemrelates to the online display of solar energy power utilization as a renewable energy. Smart Monitoring highlights daily renewable energy use. This assists the user in analyzing energy use. Analyze the effects on electrical challenges and the consumption of renewable energy.

Keywords: IoT, Solar Energy, Smart Monitoring

1. Introduction

Based on IoT, a low-cost solar panel monitoring system [1] is being developed for online viewing and performance improvement. This aid in preventative maintenance and tracking the location of faults.The Blynk IoT for monitoring is suggested and developed as an IoT-based monitoring solution [2]. A smart monitoring system is created using an Arduino IDE and a Blynk IoT to maximise efficiency. A monitoring system is built on wired and wireless networks to send parameters to a remote coordinator [3], who provides a web-based application for remote access. Using Blynk IoT, a realistic graphical user interface for online monitoring of solar PV is created [4]. The Arduino controller analyses the measured parameters and delivers the data to the server. Using Blynk IoT, a realistic graphical user interface for online monitoring of solar PV is created. The purpose of this study is to

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create an effectiveprototype of a monitoring system for Flexitank heating pad, both in hardware and software. It is an online platform that monitors the solar system in real time utilizing components [5] such as sensors andso on. The analyzed data is supplied to the mobile application through IoT (Internet of Things) for predictive maintenance and failure analysis [6]. Real-time monitoring data may also be utilized for comparison analysis, with previous data and patterns driving conclusions [7].

2. Materials and Methods

In this project, the NodeMCU served as the solar monitoring system's brain, collecting data with the assistance of other system components. Additionally, the voltage and current sensors are programmed using the Arduino programming software in order to receive data via the Blynk app. A WiFi-connected NodeMCU ESP32, solar panel, solar charger controller, heating pad, voltage sensor, current sensor, and Blynk were used to create the solar monitoring system. The goal is to keep an eye on the current and power coming from the solar panel that heats the heating pad. Additionally, the ESP32 and other components of this monitoring system were programmed using the Arduino IDE, also known as the Arduino programming language.

2.1 Methods.

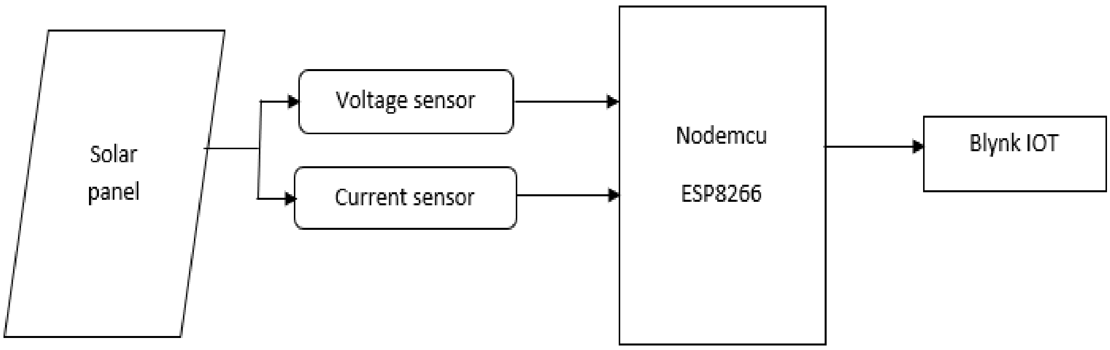


Figure 1: Block diagram of solar monitoring system

A block diagram depicts the hardware architecture and structure employed in the project. This subchapter will discuss and show the project's architecture briefly. The solar monitoring system are the significant systems in this project. Figure 1 depicts the solar monitoring system's block diagram. The purpose of this system is to read the voltage and current input/output values. The sensors' data will be wirelessly sent to the monitoring platform.

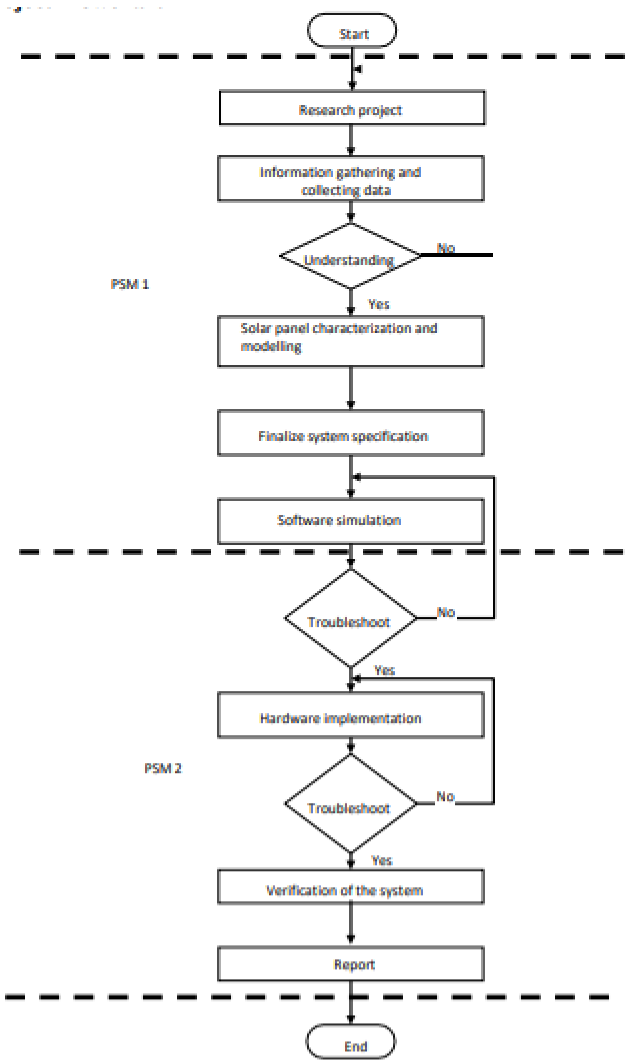


Figure 2: Flowchart of overall project

The methodology section is critical in providing students with the best answer for developing the solarmonitoring system. This section investigates and discusses the process of creating the solar monitoring system in software to determine the best technique. This project was tracked on the workflow since it helps to demonstrate the procedure the figure 2 depicts the project's overall plan, which will be developed in order to meet the goals previously mentioned. This flowchart is broken up into two sections. PSM1 receives the first phase, while PSM2 receives the second phase.

Table 1: Specification of solar panel

MODEL TYPE: SY-20	
Maximum Power Current (Imp)	1.12 A
Maximum Power Voltage (Vmp)	18.0 V
Short-Circuit Current	1.20 A
Open-Circuit Current	22.10 V
Maximum System Voltage	1000 V
Wind Resistance	2400 Pa
All technical data at standard test condition	AM=1.5, E=1000 W/ m2, Tc=25 degree C

Before modelling a solar panel, the features and characteristics of the panel must be determined. Under direct sunlight, this characteristic may be derived by measuring the solar irradiance, output voltage of the solar panel, output current of the solar panel, and output power of the solar panel. A pyranometer is a sensor that transforms the solar radiation it detects from the entire world into a measurable electrical signal.. A multimeter may be used to measure the voltage andcurrent. The voltage is measured in an open circuit, whereas the current is measured in a closed circuit.The output value is determined by the intensity of the irradiance (W/m^2). The greater the irradiance, themore (maximum) voltage and current that may be achieved.

3. Results and Discussion

IoT Based Solar Panel for Power and Current Monitoring is the name of the assigned project. Beforemoving on to hardware for the simulation component, the software approach was taken into consideration. This is to make sure that the right kinds of electronic components are chosen to design the system for proper functionality. Blynk and the Arduino IDE serve as the software components. According to several studies, the simulation results obtained through the developed Blynk from the solar monitoring system can be studied when the data obtained are converted to excel format.

3.1 Solar Panel Characteristic Testing

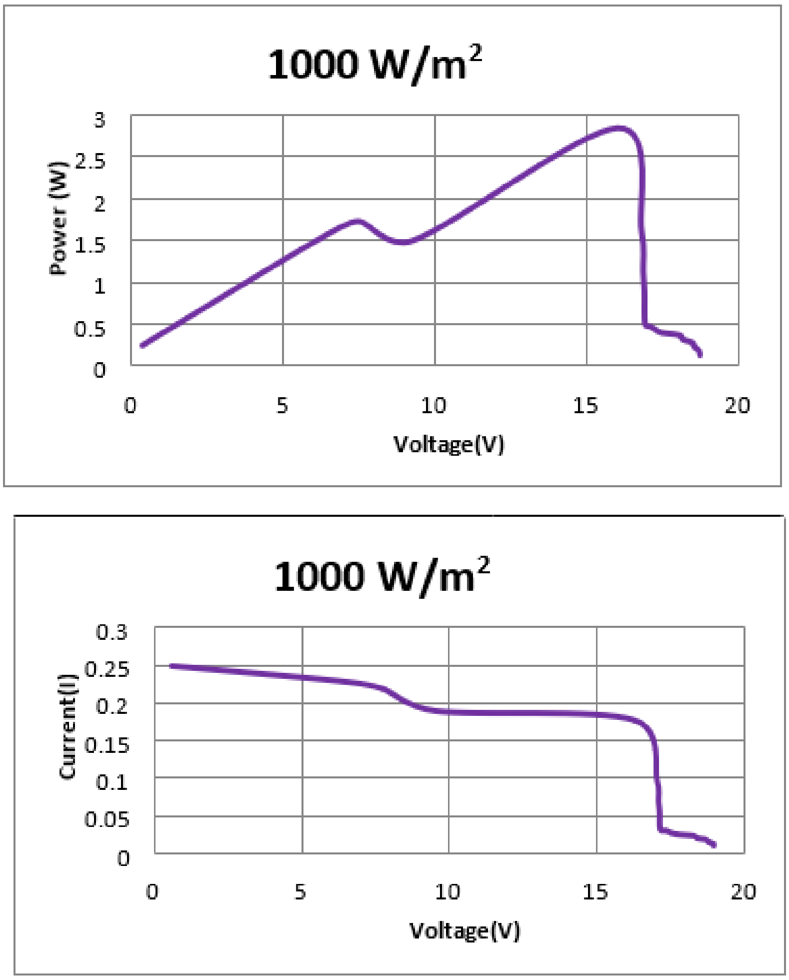
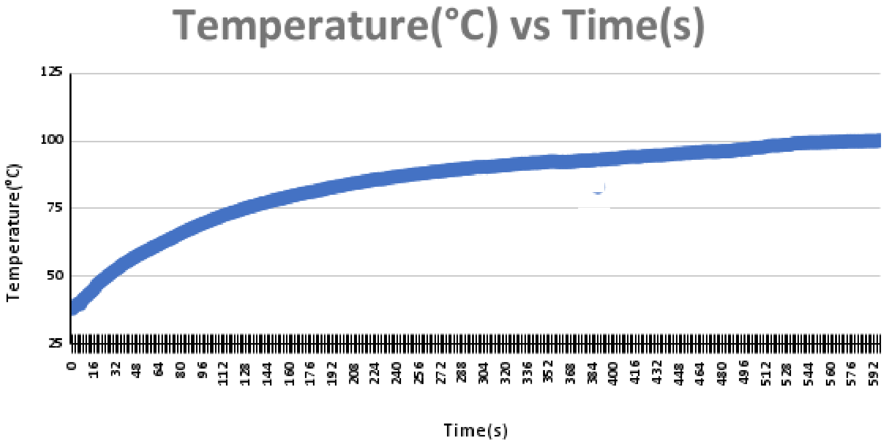


Figure 3: I-V and P-V characteristic for solar irradiance of 1000 W/m^2

Solar panel testing is performed to determine the irradiance value of a solar panel. Solar irradianceis the sun's radiative output, measured in W/m^2. On a clear day around solar noon, the usual peak valueof solar irradiance on a terrestrial surface facing the sun is 1000 W/m^2. The sun irradiance is measuredwith a pyranometer, which is located next to beside the solar panel. Solar testing, on the other hand, was done in two ways: simulation testing and actual testing. The result value is nearly identical to the theoretical value. While the actual testing is done in a real- world setting with the solar panel exposed to sunlight. According to the maximum current of 0.19 A, the maximum power point in figure 3 was 2.8 W. The voltage and current are measured by connecting the solar terminal to a resistor with a variedresistance range. The solar power produced will be affected by the irradiance.

3.2 Result Analysis



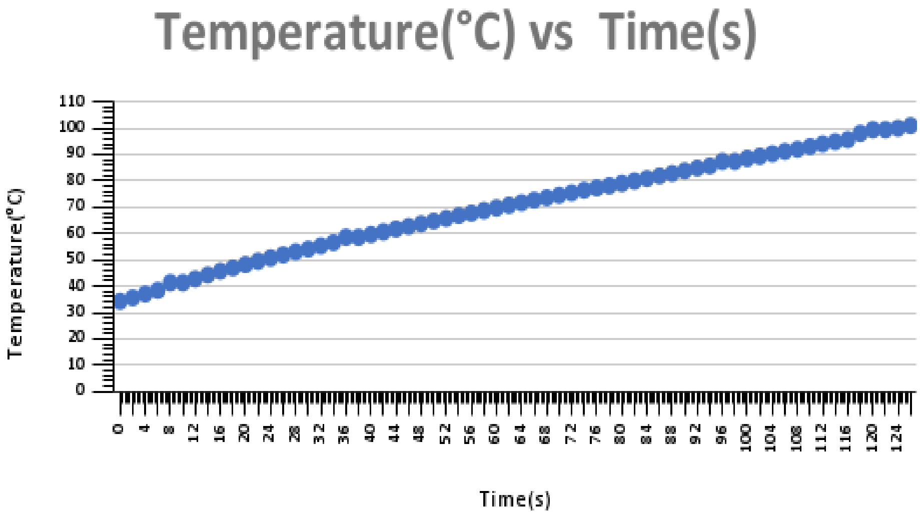


Figure 4: First and second testing using heating pad B

The heating pad B's voltage, V, current, I, and power, P are 12 V, 1.25 A, and 15 W, respectively. As aconsequence, it can detect when the heating pad starts heating up and when it cools off. It is also worthmentioning that the beginning temperature of the heating pad is 26.9 °C, with a maximum temperatureof 100 °C, resulting in an increase in the graph in Figure 4.

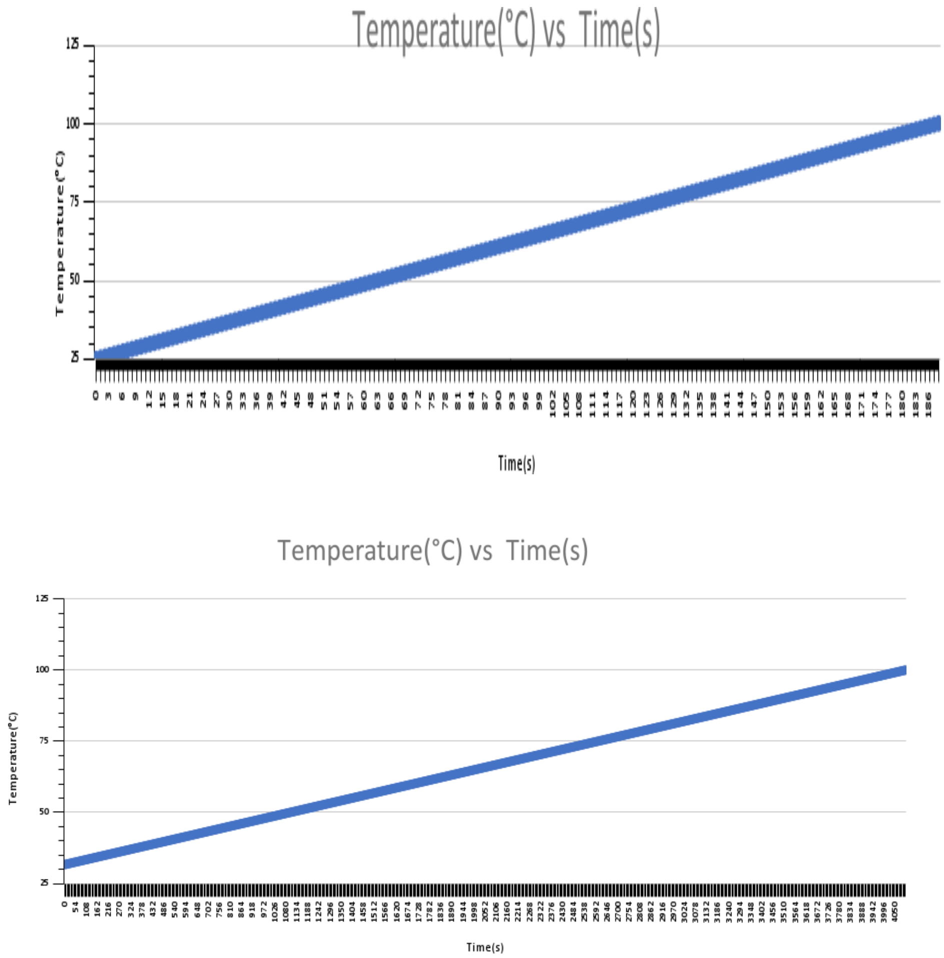


Figure 5: First and second testing using heating pad D

The heating pad D's voltage, V, current, I, and power, P are 12 V, 10 A, and 120 W, respectively. As aconsequence, we can detect when the heating pad starts heating up and when it cools off. It is also worthmentioning that the beginning temperature of the heating pad is 31.7 °C, with a maximum temperatureof 100 °C, resulting in an increase in the graph in Figure 5.

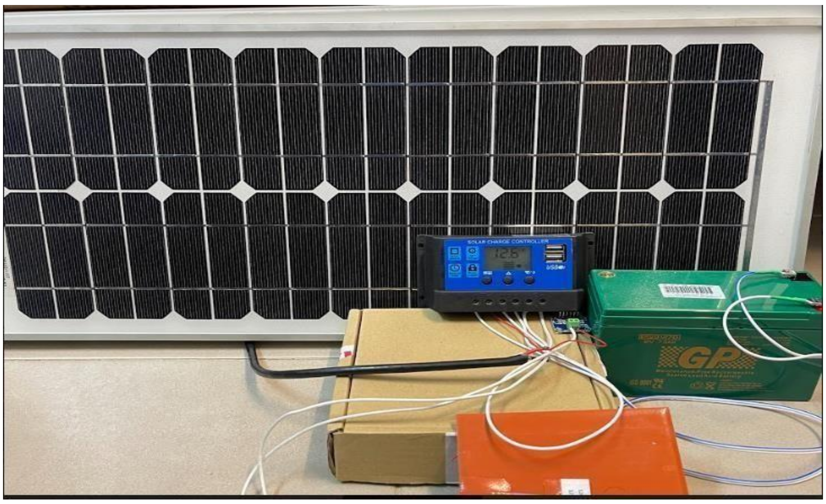


Figure 6: The proposed system's operational model.

Figure 6 displays the proposed system's operational model. To get the most output power from the solar panels, an IoT-based solar power monitoring system is created in this project. Sensors are used to capture the current and voltage parameters when solar panels convert light energy into electricity. IoT technology is used to display the received voltage and current levels. We may examine the readings onour mobile device by connecting to the Wi-Fi network because the sensors are connected to a Wi- Fi module. The readings or data are immediately updated on our mobile whenever they change. We can monitor the operation of solar panels using IoT technology, and there may be a chance to identify the issue when something goes wrong.

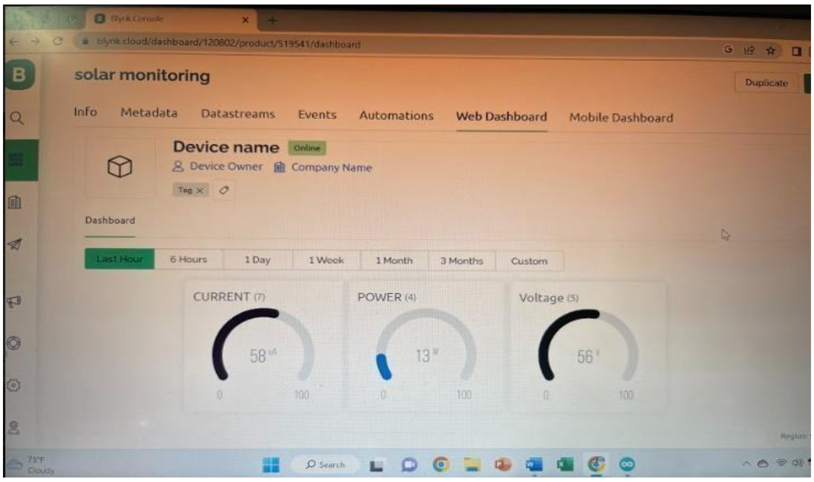


Figure 7: The gauge meter in Blynk application

The figure 7 shows a gauge meters display of the solar panel's voltage and current, as well as power values, on the application's smartphone screen. The data from the sensors was transmitted to a registeredemail address through the export capability of this Blynk application. As a consequence of this data, graphs that depict how the output system has evolved over time may be created.

4. Conclusion

Monocrystalline solar panels are employed as a power source because of their superior performanceand characteristics. The solar output is determined by the amount of sunshine received, which may be measured with a pyranometer. A solar panel cannot also be directly connected to a load without the useof a solar charge controller. In theory, the use of a solar charge controller is to manage the solar powerto the battery and to prevent overcharging and undercharging of the battery storage. maximum power point tracker is the most recent solar charge controller (MPPT). The power converter is the most significant component in the construction of the solar charge controller. Lastly, while this project has certain flaws, it can be improved for the suggestion. A buck-boost converter, whose duty is to step-up and step-down the output voltage, is the most ideal converter for obtaining a steady output voltage. Thesolar tracker may be used for this project to produce a steady output power from the solar panel.

Acknowledgement

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